GALILEO PROBE THERMAL CONTROL

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Introduction

The Galileo spacecraft was launched in October 1989 and sent on its way to Jupiter by the Space Shuttle Atlantis. It arrived at Jupiter on December 7, 1995, where it made a successful encounter with the Jovian atmosphere. The Galileo Probe was provided by Hughes Space and Communication (HSC), which is now known as Boeing Satellite Design Center (BSDC). This study describes the Galileo Probe thermal control system performance throughout the mission, including its cruise while attached to the orbiter traveling around Venus and back around the Earth for gravitational assist along its way. A detailed review of the Probe's temperatures during its encounter with the Jovian atmosphere is presented, along with a comparison of how the temperatures compared to predicts and the ground testing prior to launch.

Cruise and Coast

Thermal performance of the Galileo Probe during both the cruise and coast phases was nominal. Temperature were within $\pm 3^{o}C$ of pre-launch predictions and ground testing. Initial functional tests showed nominal performance of all Probe subsystems. After the High Gain Antenna (HGA) on the parent spacecraft failed to deploy in April 1991, warming and cooling cycles were performed by turning the spacecraft in an attempt to cycle the mechanism into releasing the stuck antenna. Probe temperatures during the thermal cycling were very closely monitored to insure no limits were exceeded. Unfortunately the thermal cycling was not able to free the stuck antenna, but no damage was done to the Probe in the efforts. A final Probe check-out was performed just prior to release from the orbiter in July 1995, again showing nominal performance of all Probe subsystems. The Probe release was completed flawlessly, and the Probe thermal control system performed nominally during the entire 150 day coast period.

Descent

Probe temperature telemetry indicated colder than expected temperatures during the early descent and warmer than expected during later descent. At the 13 bar level, the Probe RF units were at or below Qualification levels and all other science and engineering units were at or below Acceptance levels, but both were noticeably above predicts. The Galileo Probe mission was a resounding success in spite of the thermal extremes seen during its descent. The cause of the thermal extremes is believed to be higher than expected convective currents flowing through the Probe since it was not sealed and was subjected to significant buffeting during its descent. These temperature extremes were not seen during ground test since it was tested in a non-moving, stagnant environment. Additional detail on the Probe temperatures during descent is provided in the reference.

Reference

1997 AIAA Applied Aerodynamics, Plasmadynamics and Lasers, and Thermophysics Conference, 97-2456, "Galileo Probe Descent Post-Flight Thermal Correlation Analysis," Brian Mischel, Tom Rust, and Fred Linkchorst, June 23, 1997.